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ABSTRACT

This study was designed to: (1) investigate differential responding to stimuli that differ along a continuum of degree of discrepancy from a familiarized standard; and (2) attempt to determine if infants will show response decrement and recovery to conceptual categories. Fifty-five infants at two age levels (10 and 16 weeks) were familiarized with a category of stimuli, and then presented with another conceptual category that was familiar (f), similar (s), or novel (n) in comparison with the first category. Subjects in the f condition evidenced no significant recovery. Recovery at both age levels was demonstrated by the subjects in the s condition, this trend being more evident at the younger age level. Similar results were found in response to novel stimulus changes. The greatest recovery in terms of magnitude of response recovery was demonstrated by the 10-week-olds in the n condition. These results indicate that infants will habituate to conceptual categories of visual stimuli, and that rerecruitment of visual attention can be elicited by the presentation of either novel or similar conceptual categories. (Author/SB)

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HABITUATION AND DISHABITUATION OF VISUAL ATTENTION TO FAMILIAR, SIMILAR AND NOVEL CONCEPTUAL CATEGORIES IN 10- AND 16-WEEK-OLD INFANTS

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The purpose of this study was to investigate two areas of information processing capabilities in the young human infant. One of these areas had been studied frequently over the past several years, but contradictory rather than conclusive findings have been reported. Data reported by McCall and Kagan (1967) and McCall and Melson (1969) suggested a curvilinear relationship between visual attention and level of stimulus discrepency in four- and five- month-old infants. Their results indicated that infants distribute their visual attention differentially to stimuli that differ along a continuum of decree of discrepancy from a stirulus with which they are familiar. After being familiarized with a visual stimulus, infants were presented with stimuli that differed minimally, moderately or maximally from the familiar stimulus. The infants demonstrated greatest responsiveness to the moderately discrepant stimulus. While a few subsequent studies have lent support to these findings (Hopkins, Zelazo and Kagan, 1973; McCall, Hogarty, Hamilton and Vincent, 1973; and DeLoache, 1976), the majority have reported that infants tend to prefer stimuli that differ greatly from stimuli with which they have been familiarized rather than those that differ only slightly or moderately (Cohen, Gelber and Lazar, 1971; Welch, 1974; and Cornell, 1975). The subjects used in these studies were four and five months of age. It is possible that the curvilinear relationship described by McCall and Kagan (1967) and McCall and Melson (1969) in response to familiar and novel stimuli is a developmental phenomenon which begins to dis-

appear by the fourth month, and is replaced by a preference for high degrees of visual novelty. It is also possible that these preferences undergo change as the infant's cognitive structures mature and he/she is simultaneously exposed to a wider range of environmental input. Stimuli that offer new rather than redundant information may become of increasing interest. Our investigation sought to explore the existence of developmental differences that may occur between 10 and 16 weeks of age in response to a range of discrepant stimuli.

The second question our study attempted to answer is concerned with an area of infant cognitive development that has received little systematic research, and one that we think is important for understanding the ways in which the human infant categorizes the visual world. This is the area of concept development. The impetus for exploring this rather unknown aspect of infant development was the intriguing results reported by Faulkender, Wright and Waldron (1974) concerning the response of toddlers to conceptual categories. Adopting the habituation paradigm from infant research, subjects were familiarized with a set of six stimuli, all members of the same conceptual category, such as pictures of animals. Following habituation, the toddlers were sequentially presented with 18 stimuli--six were those which they had been familiarized with, 6 were different members of the same category with which they had been familiarized, i.e. six different animals, and 6 were totally novel--members of a different conceptual category, i.e. fruits. The toddlers visually attended to the familiar stimuli for the least amount of time, to the similar for an intermediate duration, and to the novel for the greatest amount of time. The habituation to the familiar set generalized to the same conceptual category. It appears from these data that by three years

of age children can process visual information in categorical groupings, and prefer stimuli that are unfamiliar. In terms of the developmental continuum when does this ability begin to emerge? The findings I wish to present to you this morning are the results of a preliminary exploration into the development of this cognitive processing ability.

Fifty-five infants served as subjects in the final sample reported here. The design included both longitudinal and cross-sectional subjects at 10 and 16 weeks of age. The 16 longitudinal subjects, 9 males and 7 females, ranged in age from 66 to 76 days, with a mean of 72.12 days, for the first experimental session, and from 107 to 120 days, with a mean of 115 days for the second. The average interval between the first and second sessions was 42.75 days with a range of 35 to 48 days. The 9 males and 10 females that comprised the 10-week cross-sectional sample ranged in age from 63 to 82 days with a mean of 72.79 days. Twenty infants, ten of each sex, served as cross-sectionals at 16 weeks. They ranged in age from 109 days to 123 days with an average of 114 days. One hundred and sixty-two infants were run to obtain the final sample. Fifty-three were dropped from the sample for inability to complete the experimental session because of state--40 for crying, 13 for sleeping. An additional 44 were replaced because of unacceptable interobserver reliability (less than 70% on three measures of reliability), and 9 for technical or experimenter error.

Infants were placed in a three-sided booth, facing a 6 x 6 inch rear-projection screen. Two observers recorded onset and offset of visual fixation on an Esterline Angus Event recorder. One observer was designated

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Insert Figure 1 about here

Figure 1. Schematic drawing of experimental booth.

as the control observer. The fixation times recorded by this observer were used as the data analyzed here. The other was the reliability observer. All subjects were run using an infant control procedure (Horowitz, Paden, Bhana, and Self, 1972). The duration of the onset and subsequent offset of each stimulus was determined by the length of visual fixation of the infant. A look was defined as at least a half second of fixation followed by continuous 2.5 second period of non-fixation. The stimulus remained on the screen until this criterion was met.

There were two conceptual categories of stimuli--one of female faces, the other of fruits. Each category contained two subsets of three slides each. Infants were randomly assigned to one of 10 stimulus conditions that comprised the three experimental conditions. Each experimental session was run in two phases. During Phase I the subject was sequentially presented with one of the four subsets of stimuli. Habituation criterion was calculated for each subject based on fixation to the first presentation of each slide in the subset. The mean of 50% of the total fixation duration was calculated, and this number used in defining response decrement. An alternative criterion of 10 seconds was employed if the criterion based on the subjects fixation was less than or equal to 10 seconds. The stimuli in Phase I were repeatedly presented in sequential order with a one-second intertrial interval until three consecutive looks of less than or equal to the response decrement criterion were recorded. When response decrement criterion was met, Phase II was begun, and the second subset of three stimuli was presented. The same habituation procedure as that Phase I was employed. There were three experimental conditions that differed on the categories of subsets that were presented during Phase I and Phase II. In the 3 familiar conditions (N = 16, 5

longitudinals; 5 10-week cross-sectionals, 6 16-week cross-sectional) infants saw identical subsets in both phases. In the 3 similar conditions (N = 17: 5 longitudinal, 6 10-week cross-sectionals, 6 16-week cross-sectionals) infants saw different subsets from the same conceptual categories--faces to faces, or fruits, or fruits to fruits. In the 4 novel conditions (N = 22; 6 longitudinal, 8 10-week cross-sectional, 8 16-week cross-sectional) two subsets from different conceptual categories were presented--faces to fruits, fruits to faces. The experimental session was completed when the infant had met response decrement criterion in response to the second subset.

I will discuss the results in terms of interobserver reliability and analysis of group data.

Two independent observers recorded visual fixation time during each session for all 55 Ss. Three measures of reliability were figured. Acceptable realibility was defined as minimum of 70% agreement on all three measures. On-time reliability concerned the judgement that the infant was fixating the stimulus. An agreement was scored as any half second interval during which both observers recorded some occurence of fixation. On-time reliability for all 71 sessions reported here averaged 88%. Off-time reliability measured the percentage of agreements and disagreements concerning the nonoccurence of fixation. Off-time was defined as any half second interval wherein no fixation time was recorded. An agreement was scored if neither observer recorded any fixation time during the same interval. The mean percent of agreement for this measure was 92.5. The third measure of reliability was calculated by comparing each half-second interval for the entire session. Agreements were defined as intervals, recorded no fixation during the interval or recorded both fixation and

non-fixation during the interval. The average percent agreement overall was 93.

Preliminary analysis of the group data on dishabituation scores and rate of habituation per phase indicated that there were no significant differences due to the sex of the subject. Also, no significant effects of the order of stimulus presentation on dishabituation or habituation rate were uncovered in these initial analyses. Based on these results, the three conditions have been collapsed across sex and stimulus conditions.

The data analyzed in the primary analyses to be presented here are based on the recovery scores between the first and second phase. These differences scores were calculated by subtracting the mean of the duration of fixation to the last 3 trials in Phase I for the mean of the first three trials in Phase II. Five separate analyses were performed to determine the effects of the changes that occurred in Phase II with respect ot the three conditions--familiar, similar and novel.

The data contained in Figure 2 graphs are the first three and the

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Insert Figure 2 about here

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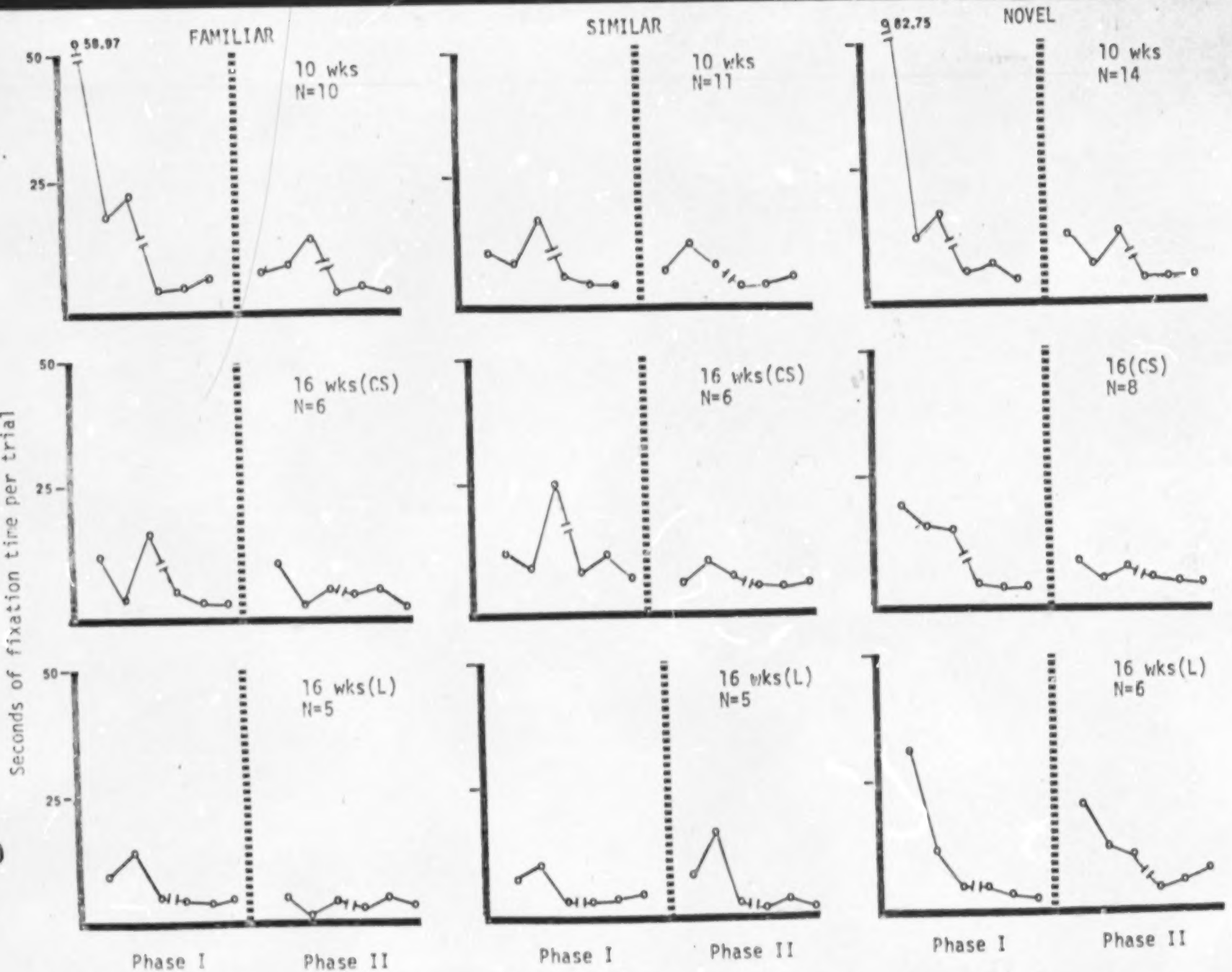
last three looks in a each phase, graphed by age of subject and experimental condition. The 10-week-old-cross-sectional and longitudinal were grouped for this analysis. At 10 weeks, a simple one-way analysis of variance revealed no significant differences among the three conditions ($F = .17$, df 2, 32, $p > .05$). No significant differences were found for the 16-week cross-sectional subjects based on condition (Kruskal-Wallis one-way analysis of variance ($H = 6.29$, df 2, $p > .05$). There were however differences at 16-weeks for the longitudinal sample. (Kruskal-Wallis one-way analysis of variance: ($H = 6.29$, df 2, $p < .05$). The source of



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McCluskey, K.A. and Linn, P.L. Habituation and dishabituation of visual attention to familiar, similar and novel conceptual categories in 10- and 16-week-old infants. SRCD, March 19, 1977.

FIGURE 2

this difference was between the familiar and novel conditions. The infants in the novel condition demonstrated significantly greater recovery than did those in the familiar condition. There were no significant differences between familiar and similar conditions and similar and novel conditions. A Kruskal-Wallis one-way analysis of variance was performed on the six groups of cross-sectional subjects (all 3 conditions at both age levels). No significant differences among the 6 groups were found (Kruskal-Wallis: $H = .95$, df 5, $p > .05$). Two comparisons of the longitudinal subjects at 10-weeks and at 16-weeks revealed no differences based on condition (Kruskal-Wallis: $H = 1.23$, df 2, $p > .05$) or an age (Wilcoxan signed ranks ($T = 62$, $N = 16$, $p > .05$).

Now what does this all mean? Well, there are 2 ways of looking at the graphs. One is that infants 10 weeks age of (the top row) and 16 weeks (the second row) cannot discriminate between categories--that the reason for no significant increase in fixation time is because the stimuli all looked the same to them. And that some infants who saw the stimuli at 16 weeks (the longitudinals in the bottom row) could accurately discriminate only novel stimuli. This interpretation is the one most frequently given for these type of data--no dishabituation means no discrimination.

That's the pessimistic way of looking at these graphs. An alternative explanation--and the one that is equally tenable is that all 3 groups represented here were in fact processing the conceptual information presented in the categories. What we have here is not a lack of recovery due to lack of discrimination but rather a lack of recovery due to generalized habituation.

In these data, at 10 weeks, there is no recovery because the

habituation in response to one category has generalized in response to a category within the same conceptual set. But why no recovery in the younger infants when a new conceptual category is introduced? It is possible that visual novelty is not yet a powerful elicitor of visual attention when dealing with these types of stimuli, and therefore the infants do not increase their fixation.

At 16 weeks we see the same-thing generalized habituation to conceptual categories. In response to novelty, however, a different trend emerges with the older infants. Novelty is becoming increasingly attractive but only significantly so in the longitudianal subjects. Why this is so, I'm not sure. It's probably one of two things. First these 6 subjects had prior experience with the same stimulus subsets six weeks before and this could have had some effect. If I was convinced that this prior experience was significantly effecting behavior six weeks later I would shift my research from concept formation to long term memory in the first half year of life. But I'm not convinced. The second explanation is that 16 weeks is a transitional stage and that infants are just beginning to prefer novel conceptual categories and that this preferences had not yet emerged in all the infants and that those that prefered novelty happened to be in the longitudinal sample.

In conclusion, based on these data I'd like to suggest the possibility that infants develop conceptual categorization in terms of visual stimuli at a very early age as evidenced by generalized habituation. I'd also like to emphasize the need for more work in this area to develop a more complete picture of conceptual formation during infancy as a potentially important aspect of gaining a fuller understanding of early cognitive development.

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